

Butanol-Acetone Mixture Blended with Cottonseed Biodiesel: Spray Characteristics Evolution, Combustion Characteristics, Engine Performance and Emission.

Abstract

Increasing energy demands and more stringent legislation relating to pollutants such as nitrogen oxide (NO_x) and carbon monoxide (CO) from fossil fuels have accelerated the use of biofuels such as biodiesel. However, current limitations of using biodiesel as an alternative fuel for CI engines include a higher viscosity and higher NO_x emissions. This is a major issue which could be improved by blending biodiesel with alcohols. This paper investigates the effect of a butanol-acetone mixture (BA) as an additive blended with biodiesel to improve the latter's properties. Macroscopic spray characteristics (spray penetration, spray cone angle and spray volume) were measured in constant volume vessel (CVV) at two injection pressures. A high-speed camera was used to record spray images. The spray's edge was determined using an automatic threshold calculation algorithm to locate the spray outline (edge) from the binary images. In addition, an engine test was carried out experimentally on a single-cylinder diesel engine. The engine's performance was measured using in-cylinder pressure, brake power (BP) and specific fuel consumption (SFC). Emission characteristics NO_x , CO and UHC were also measured. Neat biodiesel and three blends of biodiesel with up to 30% added BA were tested. The experimental data were analyzed via ANOVA to evaluate whether variations in parameters due to the different fuels were significant. The results showed that BA can enhance the spray characteristics of biodiesel by increasing both the spray penetration length and the contact surface area, thereby improving air-fuel mixing. The peak in-cylinder pressure for 30% BA was comparable to neat diesel and higher than that of neat biodiesel. Brake power (BP) was slightly improved for 10% BA at an engine speed of 2000 rpm while SFC was not significantly higher for any of the BA-biodiesel blends because of the smaller heating value of BA. Comparing the effect on emissions of adding BA to biodiesel, increasing the amount of BA reduced NO_x and CO (7%) and (40%) respectively compared to neat biodiesel, but increased UHC.